3.

SENSATION AND PERCEPTION

Exercise 1

Read the text and do the exercise that follows.

We have a multitude of **senses**. In addition to the five traditional ones, such as sight, hearing, taste, touch and smell, we have other senses, including balance, temperature, and pain, that *register* those **stimuli** that are beyond our traditional senses. The senses work together to provide different types of information about our immediate environment.

Specialised nerve endings known as **sensory receptors** located in the eyes, ears, skin and elsewhere, are *activated* by specific stimuli from the environment and from the body itself, which results in a subjective experience called **sensation**. Stimuli are *converted* or *transduced* into electrical signals by the process of **transduction** and *relayed* to the brain through nerves, where they are *interpreted* and *processed* into a cohesive and meaningful pattern, which is called **perception**.

Each sensory receptor has a particular **threshold** (or próg **limen**) below which it doesn't *respond* to stimuli. Therefore, to produce any sensation at all, the stimuli reaching a sensory receptor must possess a minimum intensity. Otherwise, they are too weak to be *detected*. Some of our senses, however, can respond to stimuli below the awareness threshold and interpret them outside of consciousness, a phenomenon known as podświadomy **subliminal perception**. This phenomenon has become the basis for the industry selling subliminal self-help recordings that promise to help people lose weight, quit smoking, or improve their self-esteem while they sleep.

When the stimulus is barely detected, we speak of this as the **absolute threshold**. The absolute threshold is therefore a critical boundary between no response and some response. Not only does the absolute threshold vary from person to person, but also from moment to moment for the same person, depending on a number of factors, such as age, interest, fatigue, attention and expectation. In most cases, though, the absolute threshold for each of our senses is surprisingly low. For instance, under ideal conditions our vision can detect a candle flame even 50 km away and our taste allows to detect a teaspoonful of sugar dissolved in about 9 litres of water. How much larger must the amount of sugar be before you notice that the water has become sweeter? The smallest change needed for a person to tell that two things are different is called the **difference threshold** or the **just noticeable difference** (**jnd**). Our ability to detect a difference in a stimulus depends on the intensity of the initial stimulus. For example, if you hold a weight of 2 kg. and add to it another 0.2 kg., then the increase in weight is apparent. However, if you hold a weight of 5 kg., you wouldn't notice the difference if 0.2 kg. was added. It takes 0.5 kg. added to the weight of 5 kg. to make the difference noticeable. As it turns out, 'the jnd is always large when the stimulus intensity is high, and small when the stimulus intensity is low.' This concept, named after its observer, is referred to as **Weber's law**.

If you are *exposed* to a continuous stimulus for an extended period of time, **sensory adaptation** occurs, and you become less responsive to the stimulus. For example, if someone near you is wearing a perfume, the scent may smell very strong at first, but after a short time you can't notice it at all. Similarly, you feel the touch of your clothes when you first put them on, but soon you *adapt* and no longer notice them.

All senses experience sensory adaptation, perhaps with the exception of the sense of pain.

NOTE

Although both **sensory adaptation** and **habituation** refer to becoming accustomed to a repeated stimulus, they are two different phenomena. Habituation is a behavioural phenomenon, whilst sensory adaptation is a physiological phenomenon. In habituation, you can have some control over whether you notice a stimulus to which you have become habituated. Therefore, after you have become accustomed to a ticking clock, you can hear it again, if your attention is brought back to it. In sensory adaptation, you have no conscious control over a stimulus. After you have adapted to an odour, you cannot make yourself smell it again.

Decide if the following sentences are true (T) or false (F).

converting stymulus into electrical sygnal

1. Transduction is the reception of sensory information from the environment. F
2. Sensation is the process of interpreting sensory information. T
3. Perception follows sensation. T (+ transduction)
4. There are no fixed thresholds. T bc it changes ?? F
5. We can never detect stimuli without being aware of them. F
6. The absolute threshold refers to the lowest detectable level of a stimulus. T
7. The difference threshold is how much something needs to change for us to notice the change. T
8. The whole business has developed around the notion that subliminal messages can help people achieve their goals. T
9. The ability to detect a stimulus depends not only on its intensity, but also on the state of the observer. T
10. Sensory adaptation occurs when a stimulus decreases in intensity. F

Exercise 2

Complete the sentences with the italicised verbs from the text in Exercise 1. Sometimes there is more than one answer.

1. By the process of transduction, environmental stimuli are converted into neural signals that are then relayed to the brain for processing.
2. A stimulus must be sufficiently intense in order to be detected.

3. Every day our senses register a variety of information from inside and outside of our bodies.

4. Once the information from the senses reaches the brain, it is processed / interpreted into what we see.

5. Sensory receptors, when activated by changes in the environment, send their information to the brain.

6. Under certain circumstances, we may respond to stimuli unconsciously.

Exercise 3

a) Match the names of the traditional senses in column A with their more formal terms in column B.

A	B
1. sense of taste d	a) audition
2. sense of smell e	b) vision
3. sense of hearing a	c) tactition
4. sense of sight b	d) gustation
5. sense of touch c	e) olfaction

b) For each of the senses, write an adjectival form. In some instances, there may be more than one form. Then use them to complete the sentences below.

1. As they grow, children explore the world around them through tactile sensations. For example, they learn about objects by putting them in their mouths.

2. If a person experiences guastatory hallucinations, his/her food may taste as if it was rotten or poisoned.

3. When an aggressive dog approaches you, your sensory receptors detect the auditory stimuli, such as barking or growling and convey them to the brain.

4. Visual illusions fool our brains into seeing something that's not really there, e.g. an animation instead of a still image.

5. Sight / Vision impairment results from a range of causes, including injuries at birth, disorders (e.g. retinal degeneration), trauma, and the old age.

6. People with damaged olfactory receptors are not able to detect dangerous odours such as those from gas leaks or fires.

Exercise 4

Choose the correct option in italics in each of these sentences.

1. Individuals with *optic*/[✓ *optical*] defects need to choose the right device for their specific needs.

2. It's not unusual for a [✓ *visually*]/*vision* impaired person to have a few low *vision*/[✓ *visual*] aids around the house.

3. Low *visual*/[✓ *vision*] individuals need help other than ordinary eyeglasses or contact lenses to be able to read the fine print or to do needlework.

4. Monoculars and binoculars are *optic*/[✓ *optical*] devices available on the market to assist short-sighted people.

5. Although at the other end of technological spectrum, aids such as audio tapes or large print reading materials can also improve [✓ *visual*]/*vision* function.

6. Damage to the *optical*/[✓ *optic*] nerve may lead irreversibly to total blindness.

7. *Vision*/[✓ *Visual*] learners respond best to information they see, and not to information they hear.

NOTE

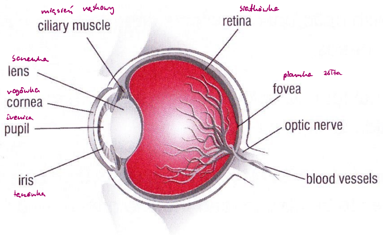
Optic and **optical** are synonyms, but they are not usually used interchangeably. **Optic** refers to anatomy (e.g. optic nerve, optic chiasm), whilst **optical** refers to sight (e.g. an optical defect) or light (e.g. optical instrument/device/aid).

Exercise 5

Complete the texts with the correct forms of the verbs in the boxes.

a) SIGHT

focus, dilate, contract, relax, constrict, project



Light rays first pass through the **cornea**, the transparent, slightly bulging outer surface of the eye. From there, light enters the eye through the **pupil**. The pupil is the black opening – aperture – in the centre of the **iris** of the eye. The iris, the coloured part of the eye surrounding the pupil, consists of muscles that control the size of the pupil and thus determine the amount of light that enters the eye. In bright light, the iris constricts (1), which decreases the size of the pupil and the amount of light entering the eye. In dim light, the iris dilate (2) making the pupil larger to increase the amount of light. After entering through the pupil, light rays pass through the **lens**. The lens is a transparent structure near the front of the eye that focuses (3) the light that enters the eye. The lens is attached to the eye with **ciliary muscles**, which change the shape of the lens to allow us to view an object at varying distances. When we are looking at a near object, the ciliary muscles contract (4) and make the lens thicker and rounded in order to focus the light rays. Conversely, the ciliary muscles relax (5) and flatten the lens when we are looking at a distant object.

Once they leave the lens, the light rays are projected (6) onto the **retina**, at the back of the eye. The retina contains different types of neuronal cells, including **cone** and **rod photoreceptors** (also known as czopki **cones** and pręciki **rods**) and kom. zwojowe **ganglion cells**. Cones are responsible for our daytime colour vision and our ability to notice visual details. Cones are located in the central area of the retina called the **fovea**, which gives us the most detailed vision. Rods are responsible for our dim light vision and thus our ability to see in a dark place or at night. They are located outside the fovea. Cones and rods transduce light rays into electrical signals, or impulses, and transmit them to ganglion cells and ultimately through the **optic nerve** to the brain. Apart from transduction, both cones and rods are involved in dark and light adaptations, during which the retina adapts to various levels of darkness and light. You must have experienced problems with vision when entering a dark place from the bright outside (dark adaptation) or the shock to your eyes when coming out of a dark place into the bright outside (light adaptation).

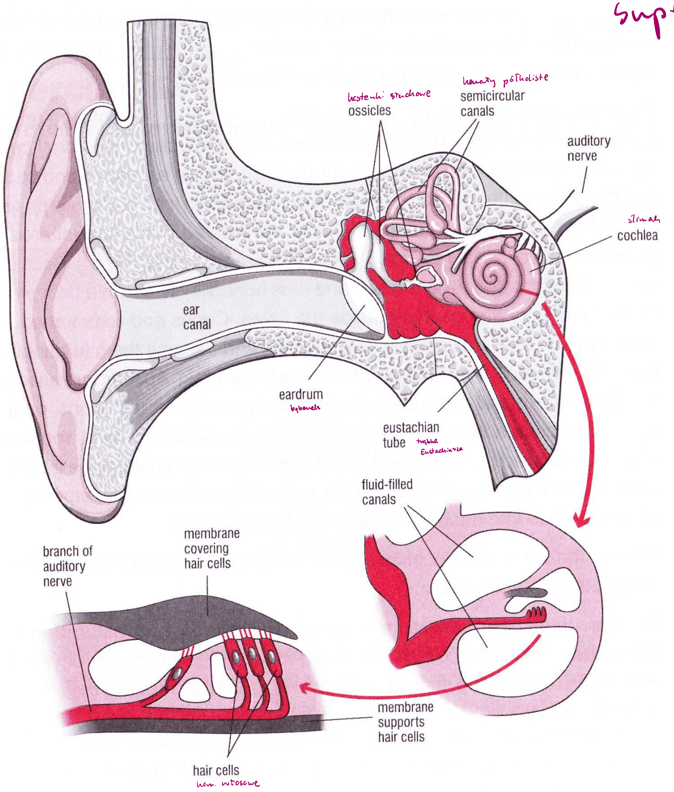
Once in the brain, the electrical signals are finally processed into the visual images that you can see.

There are three basic sensations associated with vision: **hue**, **saturation** and **brightness**. Hue is the colour that we experience (e.g. red, green, or yellow). Brightness refers to the intensity of light and saturation refers to the strength or richness of the colour.

b) HEARING

EXAM
części ucha
cała
super

strike, activate, amplify, vibrate



The human ear is divided into three parts: the outer ear, the middle ear and the inner ear. Sound waves enter the outer ear (called the **pinna**) and

małżowina uszna

activate (1) the **eardrum** (or **tympatic membrane**), causing it to vibrate (2). The eardrum transmits these vibrations to three small movable bones in the middle ear (the **ossicles**): the **malleus** (hammer), the **incus** (anvil) and the **stapes** (stirrup). Each bone causes the next bone to vibrate, amplifing (3) the sound vibrations. The ossicles pass the sound through the **oval window**, a membrane to which the stapes is attached, to the **cochlea**. The cochlea is a snail-shaped structure in the inner ear filled with fluid. Vibrations of the stapes against the oval window cause the fluid to move, which in turn causes the podstawowe **basilar membrane** to vibrate. The basilar membrane is a structure within the cochlea, which supports a layer of receptor cells, the hair cells. Each hair cell is topped with hairs, called rzęski **stereocilia**. The vibrations of the basilar membrane strike (4) these hairs and when they move, the receptor cells transduce the vibrations into electrical signals and transmit them to the brain through the **auditory nerve**. In the brain the signals are interpreted as the sounds that you hear.

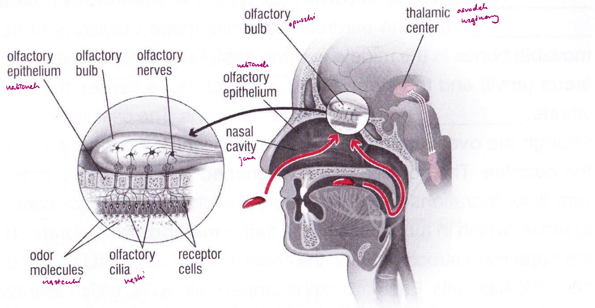
Sound waves are described in terms of their physical properties: **wavelength** (**frequency**), **amplitude** (**height**) and **purity**. They produce three basic sensations: **pitch**, **loudness** and **timbre**, respectively. Pitch refers to how high or low a sound is. Higher frequency corresponds to higher pitch and lower frequency corresponds to lower pitch. Loudness refers to the intensity or magnitude of a sound, and timbre refers to the quality of a sound, other than its pitch or loudness.

c) SMELL AND TASTE

Smell and taste are anatomically different senses, yet they are so intertwined that if you lose your sense of smell, your gustatory sensations will be adversely affected. They are both **chemical senses** because they are stimulated by **chemical substances** (**odorants** for smell and **tastants** for taste). Together not only do they help in avoiding dangers (such as gas leaks or spoiled foods), but also they allow us to appreciate a wide range of **flavours** (combinations of smell and taste).

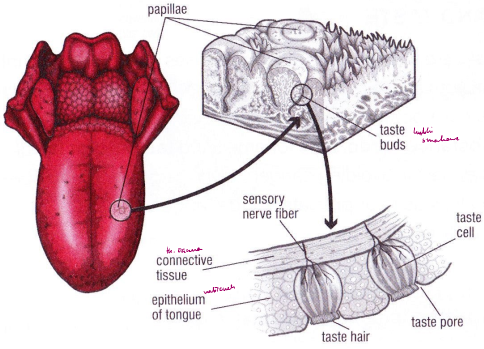
dissolve, release, produce, transport, interact

SMELL



Odorants release (1) odours into the air in the form of **molecules**, which enter the nose through the **nostrils**. Once inside the nostrils, the molecules travel to the **olfactory epithelium**, a small piece of skin in back of the **nasal cavity**. The olfactory epithelium contains millions of olfactory receptor cells. It is on the tiny **olfactory hairs**, also called **cilia**, at the top of each receptor cell where the molecules probably interact (2) with the olfactory receptor cells and, as a result, are transduced into electrical signals. These signals are transmitted through the **olfactory nerve** to the **olfactory bulb** of the brain, which then relays them to the **olfactory cortex** and from there to other brain regions. In the brain the signals are interpreted as specific smells.

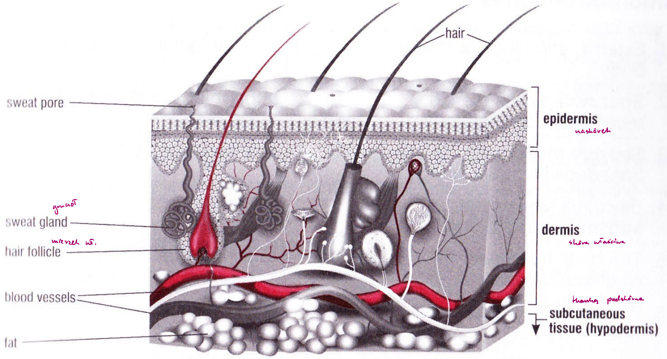
TASTE



When tastants enter the mouth, their molecules dissolve (3) in saliva, a medium which transports (4) them to the taste receptor cells on the **taste buds**. The taste buds, in turn, are mainly located within **papillae**, the small bumpy structures on the surface of the tongue, but are also found elsewhere in the **oral cavity**, including under the tongue. The molecules interact with the taste receptor cells, which produces (5) four basic gustatory sensations: sweet, bitter, salty and sour. There might be a fifth sensation: **umami**, which is a Japanese word for a meaty or savoury taste. The taste receptor cells contain **gustatory hairs**, also called **microvilli**, where the actual receptors are located and where transduction takes place. Three **cranial nerves** (the facial, glossopharyngeal and vagus nerves) transmit electrical signals to the brain that interprets the flavour of what is being eaten or drunk.

d) TOUCH

regulate, regenerate, generate



The sense of touch includes three distinct senses: pressure, pain and temperature. It originates in the skin, the body's largest organ. The skin is composed of three main layers. The very top layer, the **epidermis**, is largely composed of dead skin cells. It is constantly regenerating (1) and serves as a protective barrier to harmful agents of the environment, such as UV light, abrasion or infection. The middle layer, the **dermis**, supports the epidermis and provides it with nourishment. The dermis contains numerous sensory receptors, blood vessels, sweat glands and hair follicles. The bottom layer, the **hypodermis** (also called the **subcutaneous tissue**) is primarily made of fat and connective tissue, and helps to regulate (2) body temperature. The skin contains different receptors for touch, pressure, pain and temperature, which when stimulated generate (3) electrical signals that travel to the spinal cord and then to brain's somatosensory cortex. Because each receptor responds to different types of stimulation, different receptors are involved in stimulating the skin.

Exercise 6

Match the beginnings of the sentences with their endings, using the prepositions *through*, *into* and *to*. Use each preposition three times.

1. External stimuli enter the body	through c)	a) meaningful information.
2. Specialised cells (sensory receptors) don't respond	to e)	b) harmful environmental factors.
3. Sensory receptors transduce stimulus energy	into g)	c) sensory organs.
4. Electrical signals are transmitted to the brain	throug f)	d) the air.
5. The brain interprets electrical signals into a)	into through to	e) stimuli that are too weak to reach absolute threshold.
6. We gain knowledge of our environment through h)		f) specialised nerves.
7. Our senses adapt to i)		g) electrical signals.
8. Most substances release odours into d)		h) a process known as perception.
9. The epidermis is the protective barrier to b)		i) a stimulus that is presented continuously.

Exercise 7

Choose the correct option.

Sensing the World Through Sound

Diagnosed with retinoblastoma, a rare form of eye cancer that begins in the retina, Ben Underwood had his eyes removed at the age of three. Despite his serious disability (1), he never relied on any mobility aids (2) and yet he was able to navigate (3) through new locations safely and lead a fairly independent life. The way he did this astonished his family, his eye doctor and everyone who ever saw him in action.

Ben Underwood was one of the handful visually impared (4) individuals who mastered a form of echolocation. It is the same process used in the animal kingdom, most notably by some species of bats and dolphins. Echolocating animals generate and emit sounds into their surroundings. When the sounds hit an object, they produce echoes which bounce (5) off the object and return to their ears. Then the animals can figure out where the object is and how big it is. In the very same way, Ben was able to detect (6) the location of objects around him and create a mental image of his surroundings. By means of echolocation, he was able to ride a bike like any seeing (7) person, play basketball, 'hear' trees or parked cars and measure distances between them.

While many blind people listen for echoes these days, echolocation is regarded as a supplement to more conventional methods such as walking with a white cane (8) or a guide dog. Only few individuals are skilled enough to use echolocation alone to move around.

1. a) injury	b) disorder	[✓ c) disability]
2. [✓ a) aids]	b) help	c) support
3. a) explore	[✓ b) navigate]	c) discover
4. a) blind	b) infirm	[✓ c) impaired]
5. a) return	b) send	[✓ c) bounce]

6. a) discover [✓ b) detect] c) observe
7. a) sighted b) visual [✓ c) seeing]
8. [✓ a) white cane] b) forearm crutch c) walking stick

Exercise 8

Read the following situations and determine which of the following terms is being referenced: *absolute threshold*, *difference threshold*, *subliminal perception*, or *Weber's law*.

1. You keep looking at the oncoming bus and at some point you are able to make out what line it is. absolute th

2. In a restaurant you are served with a relatively mild dish, but still you can detect some chilli in it. absolute th

3. In the same restaurant, your partner to test your palate adds a pinch of salt to your already slightly salty soup while you are not paying attention. When you taste it, you can tell that the soup is more salty now. difference th

4. After being on a diet for a month, your friend lost about 2 pounds. Initially, the weight loss was not enough to be noticeable, however when she lost another 10 pounds, her body started to look slimmer. difference th.

5. You want to turn the radio down. You turn the knob a little bit, but it seems just as loud as before, so you keep turning until the desired volume is reached. Weber's law / dt

6. You buy a self-help audio CD with embedded messages in the hope of losing some weight. It promises that after one month of listening you will be slimmer and fitter. subliminal perception

7. If the lights in your room go off, the display on your mobile phone will make the room noticeably brighter. If the lights are on, however, the display on your mobile won't really matter. Weber's law

8. After the words 'cola' and 'popcorn' flashed on the screen during a commercial run before a movie, some people from the audience headed for the snack bar. subliminal perception

9. After a food company has changed the content of its products without informing the customers about it, you've noticed that the flavour of your favourite chocolate is somewhat bitter. difference th

10. To check your eyes, the eye doctor shows you a row of letters through two different sets of lenses. With the second set of lenses, the letters are slightly less blurry. absolute th

11. A heavy metal group was accused of hiding a satanic message in one of their songs that could be heard when it was played backwards. Some listeners were alleged to have unconsciously perceived the evil message and acted on it. subliminal perception

12. If you are at a disco, you need to shout if you want to be heard. If you are in a bookstore or a doctor's waiting room, a whisper will do.

Weber's law